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THE MOSS-ANIMALS, OR FRESH WATER POLYZOA.

PLATE 3.

BY ALPHEUS HYATT.

Among all the creatures found in our pools and lakes, none are more pleasing to the eye when carefully examined, than the Moss-Animals. These delicate animal-flowers may be found in communities, expanding their shadowy plumes in the darker recesses of our ponds, attached to the under side of submerged sticks, logs and stones.

Figures 1, 2, and 3, in the plate, show three of these communities. In figures 2 and 3 the plumes are expanded, but in figure 1 they are withdrawn, as they always are when the colony is disturbed.

The moss-animals of our fresh waters are, with two exceptions, all members of one group, called Phylactolæmata, or animals with guarded throats; that is, having a little flap outside of the mouth, which guards this aperture. The two exceptions mentioned have not this characteristic, and, therefore, belong to the same division

as their marine relatives, the Gymnolæmata, or Polyzoa with unguarded throats. Notwithstanding their harsh scientific name, the Phylactolæmata are light, elegant, mossy growths, and, when placed under a low power of the microscope, are even more beautiful than the flowers they resemble.

Their plant-like aspect, however, is a mere semblance, notwithstanding the branching mode of growth. If we examine any one specimen of the genus Fredericella, we speedily learn that the trunk is not a single, straight, solid stem, as in the plants, but made up of a series of minute, dark brown, tubular cells, arranged in a line, with the main branches and shorter twigs, also constructed of cells, arranged in a similar manner. Each cell (fig. 4) is a single animal, and contains the organs and muscles of one being, though so intimately attached to others, and so merged in the general life of the community, that it cannot, strictly speaking, be called an individual. An individual is but one animal, freely following the bent of its own will, and containing within itself an isolated, independent system of organs.

The lower portion of every cell is straight, being the continuation of the axis of the trunk, or branch of which it is a part; but the upper portion turns out of the direct line with an elbow-like bend, elevating one end above the stem. This end is free, and is surmounted by a transparent tube, which is closed by a round disc, perforated by the mouth, and bearing a crown of translucent, slender threads, called tentacles, which gracefully curve upwards like the petals of a lily (fig. 4, H). The tongue-like flap overhangs the mouth, and is continually jerked downward, instantly resuming its upright position, as if it were hinged on springs (fig. 5, I′). This is a most curious organ, and

although situated outside of the mouth (fig. 5, I″), it seems to answer many of the ordinary purposes of a tongue. It evidently discriminates between the different kinds of food, but is oftener employed to close the mouth over some struggling animalcule which obstinately refuses to be swallowed. It is a fleshy semicircular prominence formed by a fold of the disc (fig. 5, I), and is both the door of a trap, and an organ of taste combined.

The crown is interesting, not only on account of its beauty, and delicate transparency, but from the dreamy outline of each little thread, caused by the movements of the innumerable hairs investing them. The hairs, or cilia, themselves, are not visible, owing to their extreme tenuity, but the waves they make in the water can be plainly seen. So many thousands of these cilia are simultaneously moving upward on the outer sides of the threads, and downward upon their inner sides, that they force the water along in strong currents from the exterior down toward the bottom of the open-work vase where the mouth lies. The meeting of these currents coming from all sides at once, creates a whirlpool, in which hundreds of careless animalcules are continually caught and transported to the mouth. This being placed at the centre of the vortex catches all the objects entrapped by the current above, and it has, also, unfortunately for its helpless prey, a stomach beneath, which is indeed "an abyss no riches can fill." The thousands of sleepless cilia are day and night constantly in motion, drawing into the throat an endless stream of food. The stomach below is equally active, and thus all the organs work harmoniously, like machinery driven by steam, untiringly capturing and digesting the food, which, when assimilated, supplies the waste occasioned by the great activity of these parts. The threads

or tentacles, also prove useful in many other ways. They can twist together with incalculable rapidity, barring out any objectionable animal which may manifest a disposition to pry into the crown; or each one can by itself bend over and eject annoying particles; or, if the throat need a little cleaning, force its way down the tube and clear it, by pushing into the stomach whatever may be clinging to the sides. They are most amusing, however, in the angry pettishness they occasionally exhibit toward intruding neighbors. First comes an admonitory push, then a harder one, if the first is not successful, and lastly, unmistakeable blows administered with vicious rapidity by many threads in unison. Sometimes a "big fish" enters the crown in the shape of an animated speck, perceptible only when magnified twenty or thirty times its own size; then the sensitive tips of the threads curve together, and imprison the coveted morsel. Caged thus in a living net, and unable to break through the bars, it is soon exhausted by the power of the miniature maelstrom, and swept, in spite of many fruitless struggles, down into the gaping mouth.

On the exterior of the tentacles, reaching about halfway up their sides, is a thin veil, looped up and hanging gracefully between them like a delicate ruffle with pointed folds (fig. 4, G). Between this veil and the dark brown cell is the pellucid tube, and through its walls we can examine the internal organs. Directly under the tongue-like projection of the disc, or epistome, is the nervous mass, which takes the place of a brain in all the Polyzoa, (fig. 5, S). It has nerves leading to the throat, the stomach and intestine, besides two branches that go to the disc, and distribute those minute nervous tendrils, which endow them with such acute sensibility. The epistome,

or false tongue above the mouth, being only a fold of the disc, is hollow. The nerve-mass retreats into this cavity at will, probably by means of minute muscular fibres; and in this position, also, seeks security from injurious pressure, while the polyzoön is crowded within the shelter of its cell. Thus the epistome, in addition to its other multifarious uses, serves at times as a brain box.

The organs of digestion hang from the disc above, occupying the centre of the tube, and floating freely in the rapidly moving blood (fig. 5, K, K′, K″). The throat is closed at the lower end by a valve (fig. 5, K″), which opens into a gourd-shaped sack, the stomach; close by this is another valve which opens from the stomach into the intestine (fig. 5, K‴). The last is a canal leading up, side by side with the throat, for a short distance, but finally bending away from it, and opening externally through an aperture in the pellucid tube, just below the base of the ruffle, and not far from the mouth (fig. 5, $\overline{\text{K}}$).

Though the walls of these organs are variously tinted, they are not opaque, and, therefore, while not interfering materially with the view through the clearer substance of the tube, add greatly to its beauty. The yellowish throat, the stomach striped with dark brown, and the intestine, also dark brown, form a colored axis, giving a lifelike warmth to the airy delicacy of the surrounding film.

We have seen by what strange methods the food is captured, but this is not more curious than the way in which it is digested. A throatful, for we cannot say mouthful, is no sooner admitted to the stomach, than it is rolled up and down from one end to the other, with great violence. The walls of this organ take on a circular constriction, which pursues the morsel without intermis-

sion, forcing it first to one end, and then back again to the other, from which it entered, until the particles are all crushed and reduced to a pulp. These violent convulsions also serve another purpose; they squeeze the nutritious matter, resulting from digestion, out through the membranes of the stomach into the cavity of the tube and cell, where it becomes mingled with the blood, and is carried off to give health and strength to the body.

We have spoken of the plumes being withdrawn, in one of the colonies figured, and, though it has been only casually mentioned, this habit is the greatest obstacle to the observer while endeavoring to study their form. If the table be shaken ever so lightly, every unfolded crown vanishes, and often half an hour or more elapses before continued quiet allures them forth.

All the finely proportioned, transparent parts are balanced upon a fold of the wall of the tube (fig. 5, B), which is retained in its place inside of the cell by many muscles, like fine hairs, attached by one end to the fold, and by the other to the cell wall (fig. 4, N, N′, fig. 5, N). A continuation of the fold-membrane carpets the whole interior of the cell (fig. 4, 5, E), and to it are attached, near the lower end, the muscular fibres which drag the crown and the more delicate external parts into its shelter, at the approach of danger (fig. 4, M). The muscles are arranged in great broad bands rising in two trunks, each one spreading out above into numerous smaller branches. These branches are attached to the stomach, throat and disc near the mouth, and one of them to the wall of the tube not far from the base of the veil (fig. 4, M, M′, M″). They are diaphanous, but their delicate aspect is no measure of their strength. They jerk the crown and outer tube within the cell quicker than the eye

can follow them; and it is a curious fact, that after the movement is completed, and they are safely ensconced, the fibres are not content to rest, but still keep up a lively motion, writhing and twisting like bundles of minute worms.

The tentacles all the while lie gathered closely together in the sheath, formed for them by the tube, which has been doubled upon itself inside of the cell, like the finger of a glove inverted within the empty palm. When once more ready to emerge, the opening of the cell, which has been contracted by a circular band of muscle, like the mouth of a bag drawn up with a string, relaxes and permits the ends of the tentacles to protrude. These warily search for the cause of the previous alarm, and, if no hostile movements betray the presence of an enemy, the whole bundle slowly and cautiously follows, halts a moment, and then confidently unfolds its circlet of sentient threads. The Polyzoön reasons from the impression made upon these feelers, and cannot be induced to expose itself until thoroughly satisfied, by their exquisite sense of touch, that no danger lurks near its retreat.

Strange to say these plant-like creatures, singly mere animated pouches containing stomachs, show greater nervous sensibility than many more highly organized animals. They continually surprise us by actions which exhibit caution, fear, and anger to a remarkable extent, and imply a degree of complication in their relations, both social and physical, which the simplicity of the organization, and the limited sphere of its exercise render doubly interesting to the philosophical observer.

The wonders revealed in the structure of these lovely dwellers in the perennial shadows of our fresh waters, tempt one to linger, but the history of their circulatory

and respiratory functions, and their curious modes of reproduction must be deferred until the next number.

EXPLANATION OF PLATE 3. *Fredericella regina* Leidy.

Fig. 1, 2, and 3. Colonies attached to pieces of bark.

Fig. 4. Magnified view of one Polyzoön. D, brown envelope, the ectocyst; E, pellucid wall of the tube and cell, the endocyst; V, funiculus; M, M′, M″, upper branches of the muscles, the retractors; N, N′, muscles of the fold, the retentors; F, a small infolding of the endocyst, the brachial collar; G, the pointed ruffle, or calyx; H, the threads, or tentacles.

Fig. 5. Outline of the interior of part of a young specimen. Same letters as above, with the exception of B, the invaginated fold of the tube; Y, a very young polyzoön, a bud; K, the throat or œsophagus; H″, cilia surrounding the mouth; K‴, the valve opening into the stomach, œsophageal valve; K′, stomach; K⁗, intestinal valve partly open; K″, intestine; $\overline{\text{K}}$, opening of intestine, the anus; I, disc, the lophophore; I′, the little flap, the epistome; I″, the mouth; S, nerve-mass.

Fig. 6. Side view of the top of a cell, with the tube and crown drawn within; letters same as before with the exception of A⁗, contracted orifice of the cell; L, position of muscular band, the sphincter.

Fig. 7. View of the same from above.

Fig. 8. Front view, showing upper branches of the retractors, which are attached to the wall of the tube and to the disc, M″ and M′.

THE FERTILIZATION OF FLOWERING PLANTS.

BY J. T. ROTHROCK.

It is now universally accepted by botanists that there exist distinct sexes in the vegetable kingdom, and that nature's method of maintaining the existence of a specific form, is to bring the male and female elements in contact. In a normal flower, the first group of organs we find inside the corolla, are the stamens; while the yellow powder, so frequently found inside of the swollen ends (anthers), is the pollen or male element. In the centre

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Thus much for the greatest of the Royal Families of Plants. Of the others we may speak hereafter. Their importance is not less than we have ascribed to these, and in some respects they far outvie the great division before us. From the study of their extended ranks we can but gain instruction; from their wonderful involutions there will still shine out a new light on the workings of that Spirit at whose bidding "the earth brought forth grass, the herb yielding seed, and the tree yielding fruit after its kind."

THE MOSS-ANIMALS, OR FRESH WATER POLYZOA.

PLATE 4.

BY ALPHEUS HYATT.

(Continued from p. 63.)

The blood of the Phylactolæmata is colorless, resembling in this respect that of most of the lower animals. It is composed of the liquid products of digestion, which exude through the membranes of the stomach, diluted with water drawn in through innumerable pores perforating the wall of the tube. The water is the medium of conveyance for the gelatinous, nutritious liquid, probably facilitating its carriage to remote parts.

There is no organ resembling a heart to keep the blood moving, and there are no closed channels, such as arteries and veins, to conduct it among the tissues of the body. The absence of the first is supplied by cilia, which cover the interior of the tubes and cells with a dense, velvety nap, and by their unceasing vibrations sustain a healthy circulation. The course of this may be traced by the numerous floating parasites, beings of the simplest or-

ganization, consisting either of a single cell, or of larger cells containing many others, the cycle of whose lives is passed within the polyzoön, feeding upon its juices. These indicate the passage of a common stream up the branches, and a return current along the free side, which flows into each tube.

Our Polyzoön, also, has no breathing organs, neither lungs or gills to bring the blood in contact with the air, of which element there is always more or less in water, serving there as upon land, for the respiration of animals. The tentacles are supposed to be more especially devoted to this purpose, and the water admitted to the interior must necessarily purify the blood by the air it brings in, but nothing more definite is now known with regard to this function.

The Moss-animals have two modes of reproduction, one by buds, the other by eggs. The former occurs in two ways, by free buds or statoblasts, and by sprouting buds, which develop only in summer.

The statoblasts are destined to carry their burdens of vitality safely through the hardships of winter, and to perpetuate the race by founding new colonies in the spring. They appear at first in the shape of bead-like swellings from the centre of an organic cord, which connects the stomach with the cell (plate 3, fig. 4, and plate 4, fig. 1), passing between the bases of the muscles, which retract the tube. They begin as single cells, but these soon separate into two, then into four, and so on, indefinitely. The accumulated mass then presses to the outer surface of the cord, and becoming invested with a thick, horny, brown envelope (plate 4, figs. 2 & 3, w′), falls off at last into the cavity of the body. This horny sheath in some genera also acquires a solid ring, or an-

nulus (plate 4, figs. 2 & 4, w″), and in others, for example in Pectinatella (plate 4), may have the edge of the ring ornamented with delicate spines furnished with hooks.

Late in autumn the Polyzoön dies, and the statoblasts are set free to float during the long winter, the sensitive germ within being protected from the frost only by their tough coatings. They retain their vitality, however, until the warmth of returning spring awakens their suspended powers of growth. The young Polyzoön then increases in bulk, until it splits the sheath apart, and protrudes beyond the edges. The organs are well advanced when this takes place, and the tube has already acquired its adult habit of retracting the plumes upon the slightest provocation. Its youth is a sunny holiday passed in the open water, where it swims freely by the aid of cilia, which clothe the outer surface, but the sides of the statoblast are finally separated so widely, that they drop off, and the wanderer seeks a resting-place under some old log or stone. Here a little gelatine, which subsequently becomes the tough, brown envelope (plate 3, D), fastens it to the surface, and henceforth its fate is inseparably linked to that of an inanimate mass. When securely anchored, and in some cases while still free, a little bulb appears externally on one side, and, growing larger, stretches into a minute cell, within which a young polyzoön is discernable. This was primarily a tiny, saclike bud, formed by the bending inwards of the wall in the parent cell, close to the bases of the muscles of the fold (plate 1, fig. 5, Y). The throat and stomach are derived from the transverse division of the minute sac into two portions, but it remains to be ascertained whether the intestine is made by an after-growth from the stomach, or by the division lengthwise of the throat. The tentacles

arise from the thickened rim, and draw out between them a web, which afterwards receding externally, becomes the veil, and the wall of the tube is merely an elongation of the membrane connecting the rim of the sac with the parent.

The cell-bulb does not protrude externally until these organs are mapped out. The young one, though still very imperfect, begins to stretch forth its arms as soon as the cell, or cœnœcium, as it is more appropriately called, is well extended, and long before the characteristics reach perfection, gives other evidences of its natural precociousness in the statoblasts and regular buds, which spring up in their respective places within the cœnœcium. At intervals two buds will sprout in different directions, originating new branches, and thus a dendritic colony is gradually built up, which owes its origin entirely to one animal. Consequently the outer branches are the youngest, and often, as in plants, these are vigorous and quick with life, while the parent trunk is but an empty case, frequently with nothing left to indicate its position but the decaying cœnœcia, or their faint tracery in the slime.

The second mode of reproduction, by eggs, takes place only in the newly established colonies during the earlier summer months. These eggs are little colorless vesicles, developed internally from a bead-like swelling on the free side of the wall, near the orifice. When ripe they are dropped into the cavity of the cœnœcium, and there meet with the fertilizing filaments which have been developed from a similar bud upon the organic cord. We perceive from this that our polyzoön is, physiologically speaking, neither male or female, but of the collective gender, an hermaphrodite, combining the reproductive powers of both sexes.

The eggs eventually attain the size of a statoblast (about one-thirtieth of an inch long), and have an oval outline. When full grown, their exterior is also clothed with cilia, which render them capable of rapid motion, and at this period they may be sometimes seen squirming in the tube, and tossing the stomach about with great violence. No orifice for their emission from the body has been discovered, and we have every reason to believe there is none, and that they force their way into the world directly through the walls of the body. In fact, Mr. Albany Hancock, an English naturalist, has observed a full-grown egg, which obtained its liberty by pressing through the closed orifice of the cell, rending and destroying the parent in its course.

The cœnœcia, composing the trunks of the older colonies, are always empty, as previously stated, in the autumn, and it is not improbable that they are the remains of the unfortunate parents whose death was caused earlier in the season by their restless offspring, since all, even the younger autumnal polyzoa are incapable of bringing forth eggs, and produce only statoblasts and regular buds.

The polyzoön is developed from an internal bud at one end of the egg, and when sufficiently large bursts the outer envelope, coming forth like the polyzoön of the statoblast, armed with abundant cilia, by whose aid it swims. Like this, also, after a time its wandering ceases; it seeks some dismal retreat, glues itself to the surface, and becomes the progenitor of a new colony.

All Polyzoa, both marine and fresh water, in common with other attached and branching forms, such as the corals among the Radiata, have been called Phytozoa, or

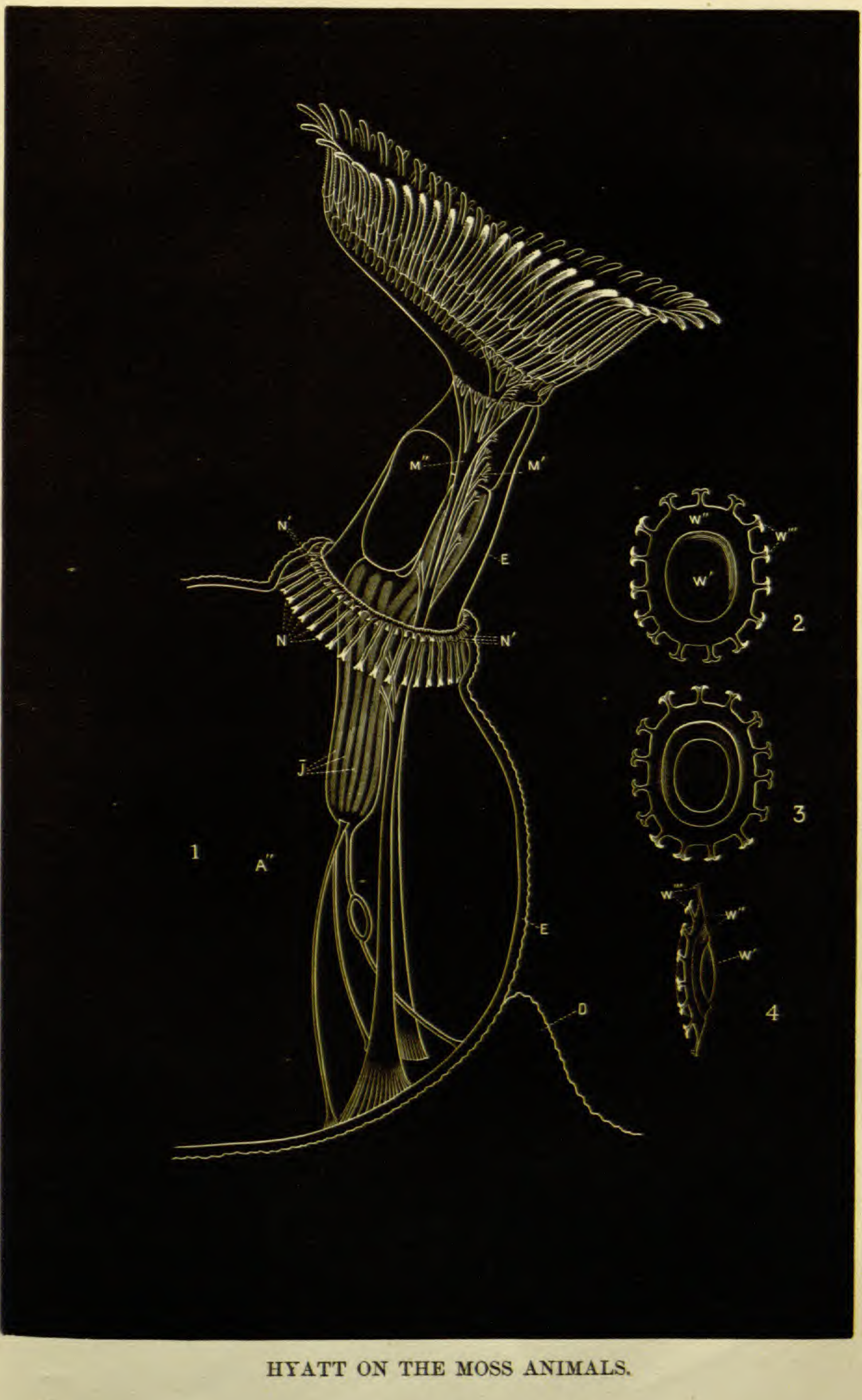
plant-animals, but, like all others of this kind, their young, born from the egg, are free.

Although thus resembling corals, they are widely separated from them by their structure. Each little animal, when reduced to its typical form, is a simple sac containing the stomach, and is allied to the clam, the oyster, and the snail, all of which have the same plan of structure. The coral, as may be seen by looking closely into any one cell, has a number of thin plates all pointing from the rim toward the vacant centre, like the spokes of a hubless wheel, and is, therefore, related to the star-fish, jelly-fish, and others, which have the parts arranged in a star-like or radiatimg manner. Thus, while by a process of budding, animals may be grouped into shrub-like colonies, with an external resemblance to each other and to the plants, with which the older naturalists classed them, their internal structure may show that they belong not only to animals, but to very distinct branches of the animal kingdom.—*Concluded in next number.*

EXPLANATION OF PLATE 4. *Pectinatella magnifica* Leidy.

Fig. 1. Enlarged view of one polyzoön, situated on the end of a branch, which in Pectinatella (see No. 2 of this Magazine) is only a hollow lobe. A″, cavity of this lobe; D, mass of gelatine below; E, wall of this lobe and tube; J, brown stripes in the stomach, the hepatic folds; M′, M″, muscles for withdrawing the tube, retractors; N, N′, muscles of the fold, which in this species is very narrow.

Figs. 2, 3, 4, the upper and lower side, and profile view of the statoblast; W′, horny sheath; W″, annulus; W‴, spines with hooks.



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was as docile as the young chimpanzee, which I also saw. It has been asserted, however, on good authority, that the young gorilla is sometimes perfectly untamable. All the authorities upon the habits of the gorilla are cited by Professor Huxley in his "Man's Place in Nature," with the exception of a curious passage in Monboddo's "Origin and Progress of Language" (vol. i. p. 281). M. Du Chaillu, in his "Journey to Ashango Land," also gives some details which are interesting, rather as tending to confirm what was previously known, than as throwing any new light upon the subject.

In fact, there is nothing remarkable in the habits of the gorilla, nothing which broadly distinguishes it from the other African apes, nor even from the ourang outang, which also builds a nest, which also assumes the erect posture now and then, and which also charges when wounded or brought to bay.

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PLATE 5.

BY ALPHEUS HYATT.

(Concluded from page 136.)

Although Fredericella has been more particularly referred to in the preceding Articles, they are, with one exception, almost equally applicable to all of the Phylactolæmata. This exception is the round disc, or lophophore, which in the other four genera changes to a horse shoe shape. (Compare Plate 3, fig. 4, with Plate 4, fig. 1.)

These four have, like the Fredericella, very euphonious names, Plumatella, Pectinatella, Lophopus, and Cristatella; and, while preserving a general identity, vary

extremely in the details of their anatomy and habits of life.

The Plumatellæ abound near the shores of our ponds, close to the surface, and are generally found with Fredericella. Better fitted, however, to endure the sun's rays, they sometimes seek places more exposed to their influence.

One sultry summer day, while searching for Polyzoa under the shelter of a bridge, my attention was drawn to the long water-grasses farther out in the stream, where, to my surprise, I found a specimen of Plumatella Arethusa, its tiny branches and living crystalline flowers glittering in the light as they swayed in the current unprotected from the heat.

The colony is like that of Fredericella, and in some species the unpractised eye would not detect the difference until the horseshoe-like discs were discovered. In others, however, such as Plumatella vitrea, the outer envelope remains gelatinous and transparent in the adult as in the young, and the tubes, or polypides, are in groups of two and more, counting sometimes twenty plumes.

The colony is dendritic, but the branches are always creepers along the surface, and there are no constrictions between the polypides, the branch being merely an elongated, undivided sac. It approximates, in this respect, to the next genus, Lophopus, and would belong to it, but that the statoblast has the plain, oval annulus of its compatriots among the Plumatellæ, which ranks it with them.

Lophopus has, also, lobiform branches, but they are supported in an erect posture by the ectocyst, a lump of clear jelly in which they are buried. The whole colony is very minute, the polypides are all gathered at the ends of the branches, and no longer occupy separate cells as in

Fredericella and most of the Plumatellæ. In the United States, Lophopus is very rare, only one specimen having been found in the Schuylkill River, near Philadelphia. In England, it is abundant upon the stems of floating duck-weed (*Lemna*) and other fresh-water plants.

My first introduction to Pectinatella and Cristatella took place some years since at Pennissewasse Pond, in Maine, one of the smallest of the liquid gems adorning that State.

Induced by the representations of a scientific friend, I visited the pond late in September, and its unexpected treasures kept me a willing loiterer for several succeeding weeks. The season was charming, full of haze and color, with an occasional leaf drifting through the still air, to remind one that the funeral cortege of the summer was passing down the year. Our way to the pond led us through a tortuous, shallow channel, studded with the blackened trunks of trees, the remains of a grove that had once overshadowed the spot where we now floated. I learned that earlier in the season this channel was much deeper, wholly submerging the shattered stumps, which were covered by luxuriant growths of Pectinatellæ, hanging over them like ivy over ruined towers. At this season, however, they were bare, the Polyzoa having sought the cooler depths of the pond.

Passing under a picturesque bridge, we entered the main lake, a long expanse with undulating shores, more like a river than a lake. One could readily imagine it winding on to the distant hills, closing the view to the northward, and the old logs which here and there lifted their sun-baked heads above the autumnal-tinted waters, half reclining with the current, added another river-like feature to the scene. We selected the oldest of these as most likely to furnish us with the objects of our search.

It was firmly imbedded, but when we finally succeeded in bringing the under side in view, the rich harvest of specimens amply rewarded our labors.

No marine or fresh-water animals of our northern climate excel the Pectinatellæ in beauty, or equal them in the tropical profusion with which they grow. The clusters, some as large as our heads, others broad and flat, were covered by hexagonal figures about an inch in diameter, traced by the plumed tubes of thousands of Polyzoa. Each hexagonal pattern, and there were hundreds in some settlements, was a separate colony. The deep, amber-color of the gelatine beneath shone through their central spaces, and each thread of the dense fringe surrounding them was stained with a tiny scarlet dot, the mouth of a polypide; the outline of one of these is given in Plate 4.

The cause of so many being assembled on one common deposit of jelly, is not the least curious fact in the history of the genus. A minute examination proves that a colony of Pectinatella is little more than a hollow case, distended by the fluids within, which prevent the soft walls from collapsing, and support the polypides protruding from the upper side in radiating lines. When this hollow case, or cœnœcium, attains the length of an inch, or an inch and a half, a crease shows itself as if a cord had been drawn tightly about the soft walls. This, deepening, finally cuts the colony into two smaller ones, and these, as they grow, divide into four, which in turn divide into sixteen, and so on. Where this increase is very rapid, the interior colonies are forced to expand upward, and, adding to the gelatine as they rise, build up, in some instances, clusters several feet in diameter, and eight or more inches in thickness.

Side by side with these, occurred thin patches of gelatine covered with what at first appeared a different species of Pectinatella. The central spaces of the colonies, however, were long and narrow, and much less brilliant, being surrounded by tawny-colored fringes of Polyzoa. This genus discards even the remnant of a branch which we mentioned in the lobes of the Pectinatella, and is a hollow sac flattened into a disc below, by which the whole colony move upon the gelatine or ectocyst as one animal.

In Fredericella, the hard, parchment-like condition of the ectocyst was owing wholly to the age of the colony; in the young, it was gelatinous.

We have seen, also, that Lophopus was buried in its own ectocyst, which remained gelatinous throughout life, and that the Pectinatellæ, though firmly attached, simply rested on theirs. And we now see Cristatella making the last step in this process, becoming entirely independent of its ectocyst, which is only a transient secretion thrown off from the creeping disc, like slime from the foot of a snail, to smooth the path over which it crawls. In large settlements the colonies lie closely together, but it is not infrequent to meet with a stray one wandering by itself. Locomotion is accomplished by a complete net-work of muscles within the sac. These, with perhaps other muscles in the walls, enable them to expand the disc in any direction, and then secreting gelatine, and holding to what they have thus gained, draw up their remaining portions. They move so slowly, however, that minute colonies require a day to get over an inch on the side of a smooth glass dish, the larger colonies progressing even more sluggishly. In Plate 5, the outline of a single polypide is given, with a portion of the net-work of internal muscles.

Cristatella is no exception in the animal kingdom; there are many instances in which compound animals move and act in unity. But here there is some hope of solving this mysterious diversity of number, with unity of will and purpose.

The nervous system, wherever it is present, whether in the distinct form of brain, nerve-mass, or ganglion, is essentially the medium of sensation and of motive power.

Now if the nervous system among the Polyzoa is a compound system, having a common trunk with branches leading off into each Polyzoön, a sensation in the main body could be conveyed to each individual, and thus the will of every minute tube be brought into harmony with all, causing the whole to move like one creature.

Fritz Müller, a German naturalist, has actually ascertained that in one of the marine species of Seriolaria, the nerves followed up the hollow trunk and branches of the colony like the dark wood in the heart of a tree, supplying each animal with a nerve. He noticed that if the trunk of the colony was irritated, that all the Polyzoa withdrew their plumes as if alarmed, and this led him to investigations, which resulted in such important discoveries.

Whether all the polypides in a colony of Cristatella unanimously resolve to move, or whether the majority rule and drag the minority at will, or whether again the desire to move is excited in the central nerve-trunk by external causes, has not yet been determined.

One thing, however, seems probable, that the unanimity of action in the little republic is due to the union of the various individualized nervules into branches, and finally into one grand trunk, otherwise parts of the movable sac might be travelling in opposite directions at the

same time, from the sides as well as from the ends, and the colony be broad and sedentary, instead of long, narrow, and progressive.

EXPLANATION OF PLATE 5. *Cristatella ophidioidea* Hyatt.

Fig. 1. Magnified view of one Polypide, isolated, showing at E (above) the upper surface of the sac, or cœnœcium, and at E (below) the creeping disc, and at Q, Q, the meshes of the internal muscles, which aid in locomotion. M, M′, M″, muscles which retract the tube and plume, retractors. N, muscles which retain the fold, which is reduced in this genus to a circular constriction, and devoid of the muscles marked N′, in preceding plates. $\overline{Z}$, clear spaces in the wall of the arm. O, the bases of muscles which move the tentacles; the upper portions of these are seen in Fig. 7.

Figs. 2, 3, and 4. Upper and lower side, and profile view of the statoblast. W′, horny sheath; W″, annular sheath; W‴, spines, only eight and five pairs of these are figured, there are in nature twenty-two short and thirty-two long spines.

Fig. 5. View of intestine with upper part of stomach and lower part of throat in the background. K, throat; K′, stomach; K″, intestine; $\overline{K}$, anus.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 151.)

HELIX HORTENSIS *Muller*. (Fig. 16.) Shell nearly globular, smooth, shining, yellow. Whorls five, convex, spire somewhat elevated, suture at extremity of last whorl curved toward the aperture. Lip slightly reflected, white, and having a thickened margin within the shell; the reflected condition of the lip disappearing at the base of the shell. Aperture rounded; umbilicus absent. The base of the shell is quite convex. Specimens are sometimes found with one or more brown bands revolving with the whorls. Animal blackish, tinged with brown; creeping disc inky; extremity dirty flesh-color.

Fig. 16.

HYATT ON THE MOSS ANIMALS.